PATENT SPECIFICATION

774,052

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COMPLETE SPECIFICATION

Method and device for the Production of Energy from Exothermal Chemical of Nuclear Reactions

I, PAUL SCHMIDT, of German Nationality, of Riesstrasse 18, München 54, Germany, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in the following statement:—

The invention relates to a method and a device for the production of utilizable energy, in which extremely high temperatures and pressures are employed in order to achieve conversions of substances.

It is known that conversions of substances, for instance, of hydrogen into helium, can be achieved only at extremely high temperatures and pressures.

The methods employed hitherto for the production of high temperatures and pressures require the use of quite considerable technical means, so that the costs of such installations are very high. On the other hand, it is not yet possible to produce with known means and in a regulated manner extremely high temperatures, such as several million degrees Kelvin, and to control the process of conversion of matter into small quantities of energy or other substances, where the quantities can be kept practically within any desirable limits, so as to obtain technically usable quantities.

It is the object of the invention to produce utilizable energy with a comparatively limited technical equipment and in a controlled manner by means of the conversion of substances, where a new method for the production of extremely high temperatures and pressures is employed.

The invention comprises also a device for carrying out the new method.

The method of the invention implies the use of pressure shock waves. The term "pressure shock wave" is defined as the narrow range of a pressure increment which is propagated with supersonic speed in an elastic medium, for instance a gas. During this process the entropy increases. Shock waves of this kind occur specifically in detonations and in the movement of bodies and gases in the supersonic range. The invention makes use of this physical phenomenon in a specific manner.

It is based on the discovery that the energy embodied in the shock wave and progressing with it is concentrated to higher temperatures and pressures when the shock waves converge. By means of such a concentration of a shock wave the energy of a pressure shock wave can therefore be raised within confined spaces to extremely high values. This energy occurs substantially as an increased molecular speed of the particles of the substance, in the direction of motion of the pressure waves. The higher the concentration of a shock wave, the higher is the energy of the collisions between the molecules or atoms at the instant in which they are seized by the pressure shock wave. One can conclude from the observation made in the investigation of pressure waves, that the compressibility of water at pressures of over 50000 kg/cm² is much higher than could be expected from an extrapolation of the static values measured at low pressures, that a crushing of the atomic electron shells is commencing. One can conclude from this that in the range of extremely high concentrations of the energy of pressure shock waves the nuclei are liberated and that then nuclear conversions of substances occur.

According to the invention, pressure waves are employed for the production of extremely high high temperatures and pressures by being made to converge repeatedly and in quick succession, so that their effects can be regulated in a simple manner.

The invention consists in the substances which are to be made to react being brought into the neighbourhood of the centre of a spherical space bounded by a hollow sphere and filled with an elastic compressible medium and pressure shock waves being produced periodically and in quick succession in the material in the spherical space, in the form of spherical waves arranged concentrically with respect to the wall of the hollow sphere and progressing in a radial direction towards

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the interior of the space, and meeting at the centre of the hollow sphere. Each spherical wave then concentrates practically its entire energy on the substances arranged in the neighbourhood of the centre of the sphere, thus bringing about the desired reactions between these substances. The energy generated in the process is then conducted away and converted into a utilizable form.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of a preferred embodiment thereof taken in conjunction with the accompanying drawings, in which:—

Figure 1 is a device for the generation of converging pressure shock waves directed concentrically towards one point;

Figure 2 is a different design of a device similar to that shown in Figure 1;

Figure 3 is a device in which electro-static forces are employed for the generation of pressure shock waves.

The device shown in Figure 1 comprises a hollow sphere 1 made of a magnetizable material, for instance, steel, whose outer surface is surrounded by a large number of electro-magnets 2 distributed uniformly over the surface and being fixed in an outer thick-walled casing 3. The whole structure is supported on a supporting frame 4. A narrow air gap 5, everywhere of uniform width, is arranged between the free front faces of the electro-magnets 2 and the outer surface of the hollow steel sphere, and transmits the magnetic forces from the electro-magnets 2 to the wall of the hollow steel shell 1. The windings of all electro-magnets 2 are connected to a common source of alternating current 6, which is supplied from an electric network or from a known type of current generating installation, not shown. The source 6 of alternating current is provided with a regulating device 7 for the regulation of the current strength in the circuit of the elctro-magnets 2; a device 8 for the regulation of the frequency is also provided. The frequency can be regulated, for instance, by means of an already known method, where a motor generator set is provided as the source 6 of current, whose speed of rotation is adjustable, or a known type of electronic control device with grid control can be used. The pipe 9 admitting the substances participating in the reaction, shown symbolically by the arrow 10, to the centre M of the sphere, and also a pipe 11 by means of which the substances flowing through the neighbourhood of the centre M in the direction of the arrow 12 are conducted towards a collecting point, are fixed in the frame 4. The inlet pipes 29 and the outlet pipes 30, designed as pipes for gas, steam or liquid, are employed for the collection and removal of the generated energy; they remove the energy passing from the interior of the sphere through its shell. The medium admitted through the pipe 29 is therefore heated to a higher temperature as it passes round the sphere. The medium is conducted through the pipe 30 to a heat engine, not shown, for instance a steam turbine, which converts the generated energy into utilizable mechanical energy.

The device acts in the following manner:—

After the hollow sphere 1 has been filled with a substance, for instance with hydrogen, which may be under a pressure of several metric atmospheres, for instance 50 kg/cm², the source 6 of current is switched on by means of the switch 13 so as to energize the electro-magnets 2, so that the electro-magnets 2 are energized by a pulsating or alternating electric current. The electro-magnets 2 attract at exactly the same time the wall of the hollow sphere 1 made of a magnetic material, since they are all in the same circuit, and at twice the frequency of the energizing current, and let it spring back periodically, so that mechanical vibrations are set up in the wall 1. The said mechanical vibrations can be tuned to the resonant frequency of the waves in the hollow sphere 1 by regulating the frequency energizing the electro-magnets 2.

The internal surface of the hollow sphere 1 meets rhythmically the hydrogen molecules inside the hollow sphere and produces first of all radical collisions of these molecules, which lead in a known manner to the formation of concentric pressure waves, as the amplitude of movement of the wall 1 increases. The shape of the pressure waves is that of a spherical wave 14 as shown in Figure 1, which is propagated at the instant shown in the illustration in the direction of the arrow 15 towards the centre of the space bounded by the hollow sphere 1, so that its energy is concentrated as it approaches the centre of the sphere. Due to the concentration of the energy of the spherical short wave 14 as it approaches the centre of the sphere, the hydrogen particles at the centre of the sphere or in its immediate neighbourhood are pushed together with a considerable amount of energy, so that extremely high temperatures and pressures result.

By virtue of the relevant physical laws the temperatures and pressures which can be achieved in this manner can be calculated. The calculations indicate extremely high values, even at boundary conditions, that is to say, vibrations of the spherical wall 1, which can be achieved without great technical difficulties.

If the molecular-kinetic calculation is based on a sphere diameter of 2m, and impulses are assumed which give the molecules in the space inside the hollow sphere, near its surface radial impulse velocities of from 10 to 100 m/s and only small pressure increments, the calculated temperatures in the neighbourhood of the centre are of the order of magnitude of

10^8 to 10^9 degrees Kelvin. A calculation according to the laws of the dynamics of gases, assuming a uniform distribution of matter, that is to say a continuum, leads to values of the temperature of the same order of magnitude. In the same connection the values of the pressure are also found to be very high.

One can conclude that at such high temperatures and pressures nuclear reactions will occur, so that, for instance, the nuclei of hydrogen combine to form nuclei of helium. Large amounts of energy are released during this process and it is essential that only a very small part of the reacting substance, that is to say, the part in the immediate neighbourhood of the centre of the sphere, is acted upon during a short instant by a pressure shock wave, according to the method of the invention. Thus this method of obtaining energy for useful purposes becomes not only amenable to technical control, but it is also regulated by the controlled intensity of the vibrations of the shell of the sphere. The effective temperature and pressure range in the centre of the sphere can be varied by changing this intensity, so that the quantities of converted substances and of generated energy can be regulated.

It is also possible to employ the quantities of periodically liberated energy for the maintenance of the periodically generated pressure shock waves, because the liberated energy in its turn is generated suddenly, as the pressure shock wave passes through the medium.

It is also advantageous to tune the frequency of the vibrations of the shell 1 of the sphere to the time of passage of the pressure shock waves through the sphere in such a way that the shell of the sphere moves towards an approaching pressure shock wave, thus increasing the amplitude of the pressure shock wave by resonance.

Figure 2 shows a design of the device different from that shown in Figure 1. In this design electro-magnets 16 having a special shape are supported on the inside of a supporting shell 3 having the shape of a thick-walled sphere. They are arranged at some distance from the hollow sphere 1. The space between the hollow sphere 1 and the spherical casing 3 is filled with a liquid 17, which transmits to the hollow sphere 1 the vibration generated by the magneto-striction of the magnets 16. The magnets 16 are energized as in the example according to Figure 1 by means of a source 6 of current; the intensity of energization is regulated by means of a regulator 7, while the frequency is controlled by the regulator 8. Apart from this, the processes in the interior of the hollow sphere 1 proceed in the same manner as described above with reference to Figure 1.

The purpose of arranging a medium which at comparatively moderate pressures is practically incompressible, that is to say, the liquid 17, between the magnets 16 and the hollow sphere 1, is to ensure that the elastic hollow sphere 1 is hit always along its entire surface at the same time by a pressure shock, so that a good spherical vibration is set up. On the other hand, the liquid 17 absorbs the energy emitted by the sphere 1, and radiated from the neighbourhood of the centre M of the sphere. The liquid is therefore constantly renewed through inlet pipes 31, and the same quantity is constantly removed through outlet pipes 32, after the liquid has been heated by flowing round the sphere 1. The liquid is then passed to a heat engine for the production of utilizable energy. If the liquid is water, mercury or the like, it can be converted into steam or mercury vapour or the like by reducing the pressure, and passed through an elastic-fluid turbine. The liquid is admitted through the pipe 31 at a pressure which is higher than the mean pressure of vibration of the liquid 17, and it is removed through the pipes 32 at a lower pressure. The pipes 31 and 32 are made rather narrow and long, so that the inertia of the flowing liquid in these pipes is practically not affected by the changing pressures in the space of the liquid 17.

The operation of the device shown in Figure 3 is based on an electro-static principle. The hollow sphere 18 consists of an insulating material, for instance porcelain. A metal shell 19 is supported on its outer surface, and connected to a source 20 of potential. The entire hollow sphere 18, 19 rests on the insulators 21, so that it is insulated with respect to the frame 22, since in this design the inlet pipes and outlet pipes 23 and 24 are also made of an insulating material.

The source 20 of potential establishes at its pole connected to the metal shell 19 a negative voltage, while its other pole is earthed.

Positively charged particles of matter, for instance positively charged gas particles 25, are introduced into the interior of the hollow sphere; they will collect in the neighbourhood of the interior wall of the hollow sphere 18 made of an insulating material, so as to form a spherical shell, when the outer metal shell 19 is negatively charged.

The potential source 20 is then controlled by means of the regulator 26 in an already known manner in such a way that the negative voltage admitted from the potential source to the metal shell 19 pulsates very strongly at an adjustable frequency. Due to the pulsation of voltage the positively charged particles of matter 25 inside the hollow sphere 18 are periodically attracted and repelled so that they perform radial motions in the direction towards the centre M of the hollow sphere 18, as shown by the arrows 27 and 28. These pulsations of the particles of matter, which occur at exactly the same time, can have immediately the nature of a pressure shock wave, or they may lead to the formation of

spherical shock waves in accordance with known laws of dynamics of gases, where these spherical pressure shock waves concentrate their energy in the centre of the sphere. The energy formed in the neighbourhood of the centre of the sphere must be removed in this design with the gas which has participated in the reaction and which leaves the sphere through the pipes 24. In order to ensure that the temperature does not exceed a level which can be controlled by technical means, it is convenient to pass large quantities of gases through the pipes 23, so that only a small part of the substance reacts. Also, a liquid can be introduced additionally or exclusively. The gaseous medium removed through 24 is then passed in a known manner to a steam turbine or the like in order to produce utilizable energy.

The spherical shape of the pressure shock waves, which is employed according to the invention, has the advantage that the generation of a vibration of the contents of the sphere at any part of the interior spherical surface will produce a reflexion of the vibration at the opposite part of the interior spherical surface. If the frequency of vibration of the spherical surface is tuned in such a way that the spherical surface always meets an approaching pressure wave, the intensity of the pressure is increased by resonance at the spherical wall. Thus pressure shock waves can be achieved which have already at the internal surface of the hollow sphere a considerable intensity, even when the amplitude and frequency of the vibration of the wall of the hollow sphere is quite low. Thus pressure shock waves with a high pressure increment and a correspondingly high vectorial molecular velocity can be produced without a major technical effort.

It is known that when a harmonic wave passes through a medium, a wave with a shock front is formed automatically after a short while, because a harmonic pressure rise at considerable pressure differences, as in this case, is not possible according to the laws of dynamics of gases, but must lead to the formation of a shock front. Therefore, the generation of a wave at the interior surface of a sphere can start with a harmonic vibration of the spherical wall, for instance, due to the energization of the poles of magnets at 50 cycles per second, which can easily be carried out in practice.

The regulation of the reactor can be ensured by regulating the intensity of vibration of the wall of the spherical shell. This can be effected, for instance, by varying the strength of the current passing through the windings of the electro-magnets 2. Also, regulation can be effected by changes in the frequency of vibration of the wall of the sphere. In this case it is advantageous to vary the periodicity of the vibrations of the spherical surface, so as to achieve a superposed variation in the intensity of the pressure shock waves, in the manner of heterodyne vibrations. A regulation of this kind will always ensure that a number of pressure waves of particularly high intensity will follow after a number of vibrations of low intensity. Further possibilities of adjustment consist in changes of the pressure or of the mean normal temperature of the contents of the hollow sphere.

If the pressure waves are regulated in accordance with the heterodyne principle, the contents of the sphere can be heated in the neighbourhood of the centre of the sphere, due to an increase in the entropy, which occurs in connection with pressure shock waves. The small pressure increments occurring in the course of a duration of a superposed vibration, subject the core of the contents of the sphere to a temperature rise of a normal kind, that is to say, to a powerful uncontrolled molecular movement, due to the rise of the entropy of the substance in this part of the sphere. The following maximum of the pressure increment of the pressure shock waves find therefore in the centre of the sphere a medium heated to a high temperature. It is immediately obvious that the effect of a pressure on a heated medium may be more intensive there than in the case of a cold medium.

The use of comparatively low frequencies is particularly significant and advantageous in the operation of the reactor. Such frequencies of vibrations can be achieved not only without technical difficulties, but it is also possible to impress each vibration or each short wave with a high quantity of energy in a simple manner. The quantities of energy given to each vibration are in many cases higher than could be given for instance, to an ultrasonic wave. Since it is important in this invention to give each pressure shock wave a quantity of energy as high as possible, the use of ultrasound, for instance, is not found to be very advantageous in this connection.

It is found that the spherical wall must make about 1000 to 2000 vibrations per second if the sphere is filled with gaseous H_2 and the reactor is operated by vibrating the spherical wall, having an internal radius of 1 metre, in resonance with the wave motion. But also an integral fraction of this number of vibrations can be employed, and also an integral multiple. In this order of magnitude of frequencies, quoted as an example, the waves have considerable lengths. This has the advantage, compared with high-frequency waves, that the arrangement can be adapted without great technical difficulties to technical requirements implying deviations from the strict physical requirements and to a balancing of disturbing influences.

The reaction is completed within a very short interval of time, when pressure shock waves are employed. It seems to be particularly desirable for certain applications of the

reactor, where substances are formed which may easily decompose, to make it possible to remove the substance, after the method has taken effect for a very short while, immediately from the area of maximum temperature.

If the hollow sphere is filled with liquid substances, in principle the same physical conditions will be obtained as described above for gaseous fillings. Thus, for instance, it is possible to fill the sphere with liquificd hydrogen or with solid substances. In these cases the pressure shock waves are propagated at higher speeds and with higher pressures, which are more convenient owing to the preponderance of the "vectorial" temperatures, that is to say, the temperatures generated by the pressure shock waves, compared with the conditions which can be achieved with gases in the neighbourhood of the centre of the sphere. Also, in the use of liquid or solid substances for filling the sphere, the zone inside the sphere can be kept in the gaseous or liquid state by means of heat radiated radially from outside against it, if the radiation of the pressure shock waves does not automatically lead to a change of the state of this nature of the contents within small radii.

The arrangement according to the invention is not confined to nuclear reactions; it can be used with advantage also to effect conversions of substances which can still be called chemical reactions but for which unusually high temperatures and pressures are necessary or convenient.

In some cases it may also be useful to arrange substances which are to be influenced by nuclear means or substances which are to be exposed to very high temperatures in order to produce thermal or chemical effects, only in the neighbourhood of the centre of the sphere, without exposing these substances to nuclear reactions in the proper sense.

From the technical point of view, the neighbourhood of the centre of the sphere is not only characterized by having an extraordinarily high temperature, but also by a high pressure, the properties of which, in particular in connection with high temperatures, can be employed to produce technically advantageous changes in substances according to the purpose of the invention. The possibility of producing controlled effects within only a short instant, may be of some technical significance in some cases.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

What I claim is:—

1. A method for the production of energy at extremely high temperatures and pressures, in which substances which are to be subjected to an exothermal chemical or nuclear reaction are brought into the neighbourhood of the centre of a space bounded by a sphere and filled with an elastically compressible medium, and are removed from the sphere after the reaction, and in which pressure shock waves are produced periodically and in quick succession in the medium in the spherical space, in the form of spherical waves concentric with respect to the wall of the hollow sphere, which are propagated in a radial direction into the central part of the space and concentrate their entire energy in the neighbourhood of the centre of the hollow sphere on the said centre and bring about the desired reactions between these substances and substances arranged in the neighbourhood of the said centre and bring about the desired reactions between these substances and in which the energy obtained is conducted away and converted into a utilizable form.

2. A method according to Claim 1, in which the pressure shock waves are generated by means of impulses produced outside the spherical space and transmitted to the material of the hollow sphere and of which not only the strength but also the succession in time can be controlled.

3. A method according to Claim 2, in which the pressure shock waves are generated by periodically varying changes in the state of energy of the wall of the hollow sphere.

4. A method according to Claim 2, in which impulses are transmitted periodically to the hollow sphere at such a frequency that resonance is obtained between the course of the pressure shock waves and the vibrations caused by the impulses.

5. A method according to Claim 3, in which electrically charged particles of matter, preferably in the neighbourhood of the surface of the space bounded by the hollow sphere, are periodically accelerated and retarded by means of periodic changes of an electric potential field acting uniformly, and radially on the said space from the outside, in order to generate the pressure shock waves.

6. A method according to Claim 5, in which the frequency for the generation of the pressure shock wave is tuned to the natural frequency of vibration of the contents of the hollow sphere.

7. A method according to Claim 1, in which the substances participating in the reaction are supplied through ducts to the neighbourhood of the centre of the sphere and removed again from this neighbourhood.

8. A device for generating energy at extremely high temperatures and pressures, in which a hollow sphere is provided, the internal space of which is filled with a substance capable of exothermal chemical or nuclear reaction and which is also provided with pipes projecting into the interior space of the hollow sphere and employed for admitting and removing the substances participating in the reaction, and with media surrounding the external surface of the hollow sphere on all sides, which emit impulses periodically and in quick succession, thus generating pressure

shock waves in the form of concentric spherical waves in the substance filling the interior space of the hollow sphere, where the pressure shock waves propagated radially and uniformly towards the centre of the sphere concentrate their energy on the substances participating in the reactions in the neighbourhood of the centre, initiate the desired reactions and in which suitable arrangements of means for the collection and conversion of the energy of reaction into utilizable energy are also provided.

9. A device according to Claim 8, in which the means for the emission of impulses are electromagnets arranged in the immediate neighbourhood of the hollow sphere consistent of an elastic magnetic material, which are periodically energized at the same time and thus by means of their attracting forces cause the wall of the hollow sphere periodically to be extended on all sides, and let it spring back to its initial position when the energization is removed.

10. A device according to Claim 8, in which the means for emitting impulses are electromagnets, which are arranged in a bath surrounding the hollow sphere and consisting of a practically incompressible fluid, at equal distances from the surface of the hollow sphere and are energized periodically by a common electric circuit where the liquid transmits the impulses due to the periodical energization of the electro-magnets to the wall of the hollow sphere.

11. A device according to Claim 8, in which the hollow sphere is made of an insulating material and is covered on its outer side with a conducting layer to which a pulsating current from a source of electric current is admitted, while in the internal space of the hollow sphere ionized particles, atoms or molecules are available, which collect in the neighbourhood of the surface of the space bounded by the hollow sphere and perform periodical radial motions under the effects of the varying electrical voltage admitted to the outer conducting layer of the hollow sphere.

12. A device according to Claim 8, in which at least two preferably coaxial pipes projecting through the wall of the hollow sphere are provided, whose axis passes through the centre of the sphere, and of which one is connected to the feeding devices for the substances participitating in the reaction, while the other collects the products of the reaction from the neighbourhood of the centre of the hollow sphere and removes them to a collecting point.

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3 SHEETS

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SHEET 1

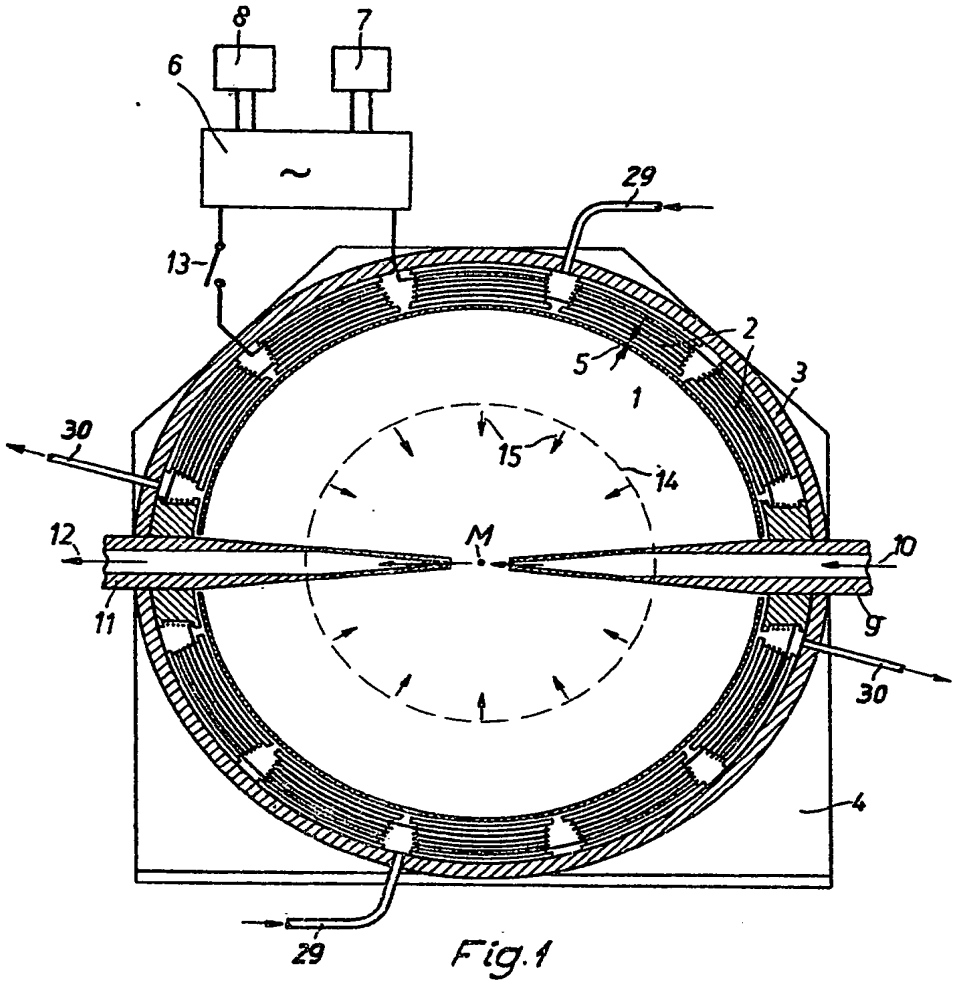

Fig. 1

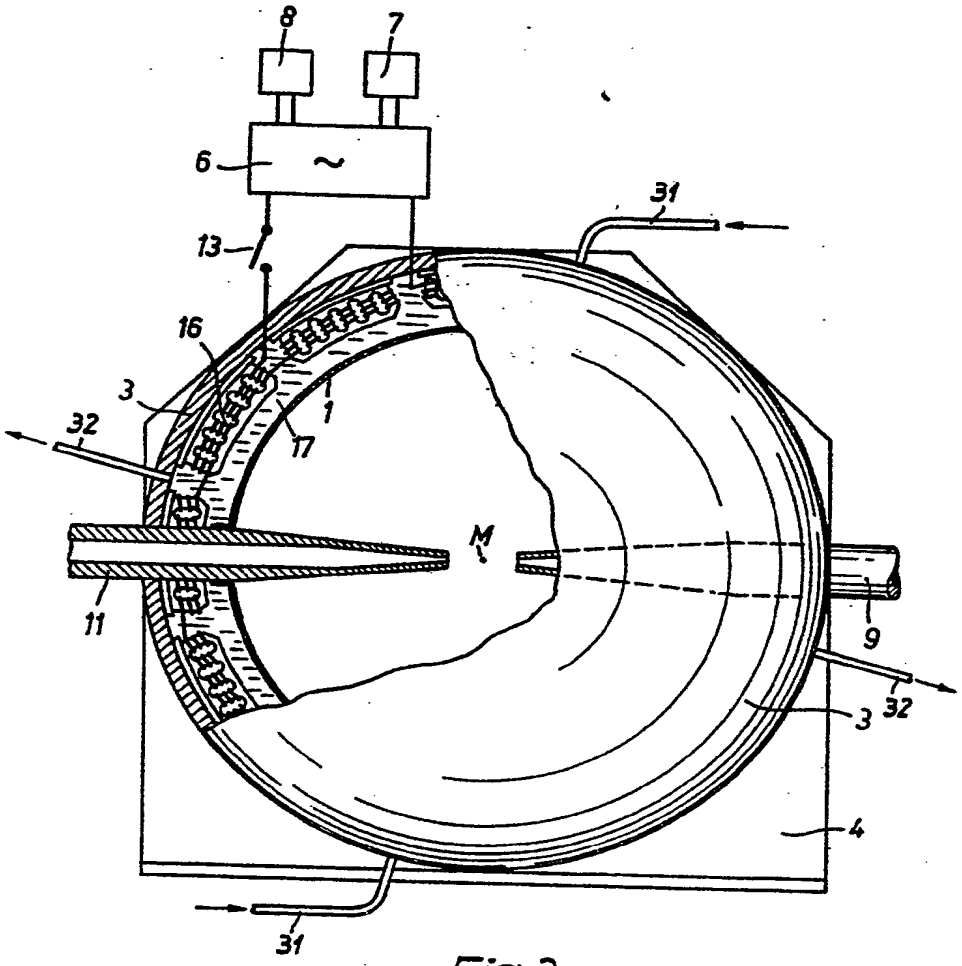

Fig.2

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SHEETS 2 & 3

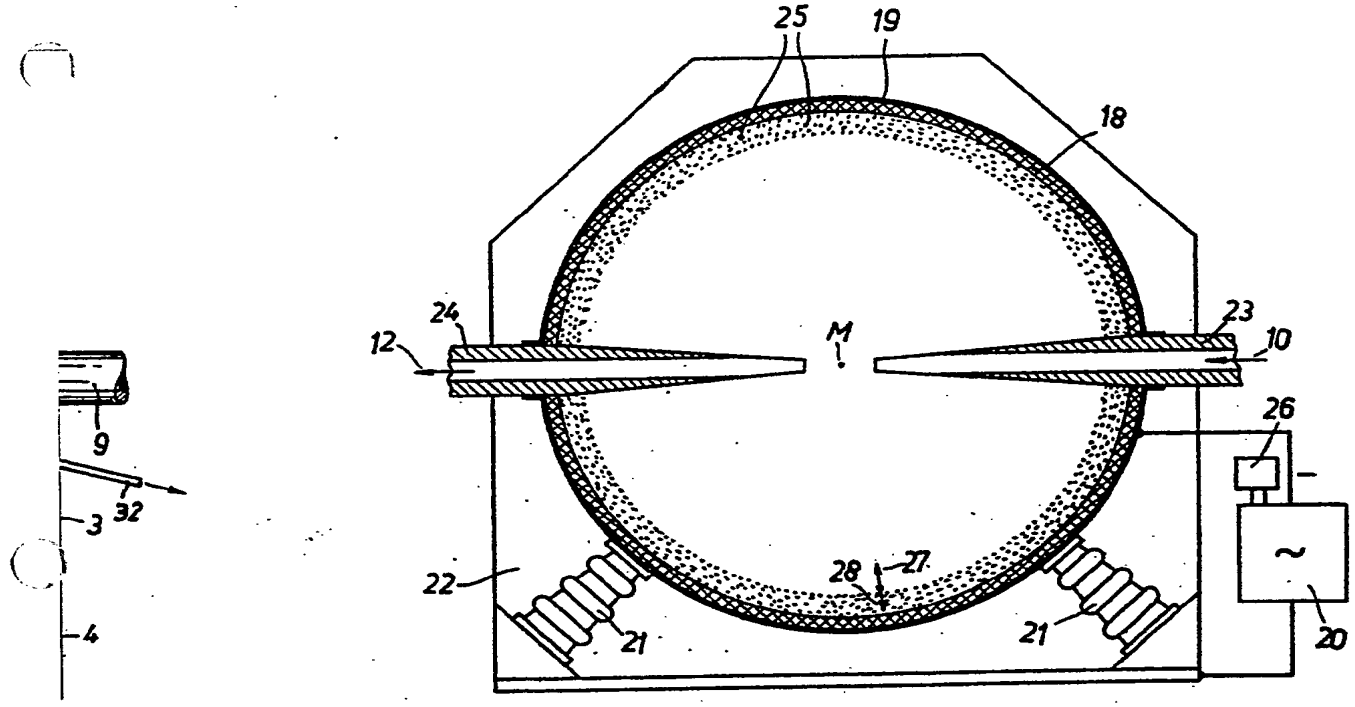

Fig.3

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SHEETS 2 & 3

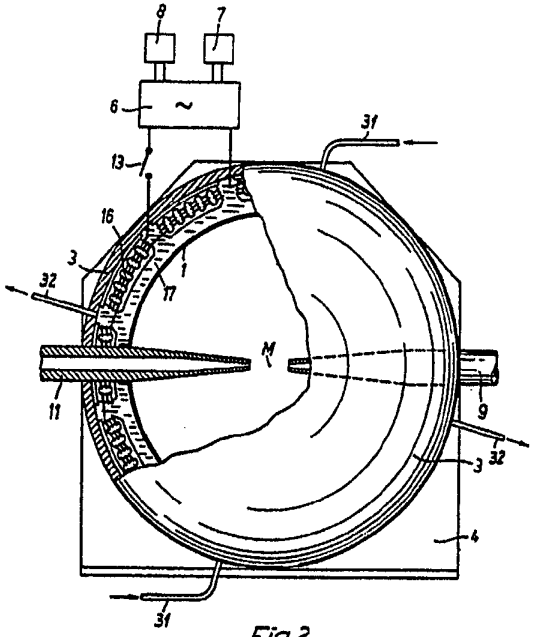

Fig.2

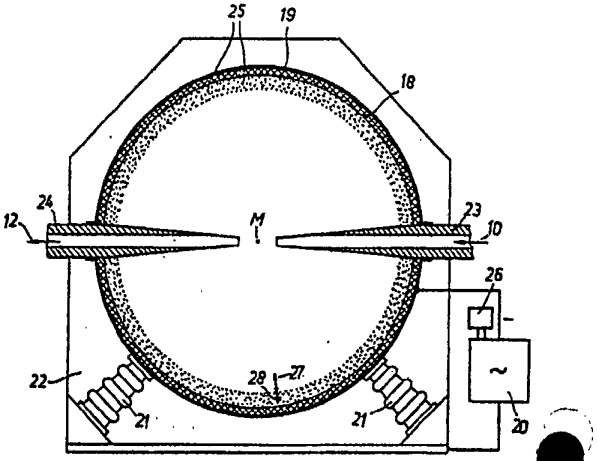

Fig.3